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**HAWAII AGRICULTURAL EXPERIMENT STATION  
HONOLULU, HAWAII**

Under the supervision of the  
**UNITED STATES DEPARTMENT OF AGRICULTURE**

**REPORT OF THE  
HAWAII AGRICULTURAL EXPERIMENT  
STATION**

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## HAWAII AGRICULTURAL EXPERIMENT STATION, HONOLULU

[Under the supervision of the Office of Experiment Stations, United States Department of Agriculture]

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Under the supervision of the  
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## REPORT OF THE HAWAII AGRICULTURAL EXPERIMENT STATION, 1927

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### SUMMARY OF INVESTIGATIONS

By J. M. WESTGATE, *Director*

During the year the station continued to encourage in every practicable way the development of a number of local minor agricultural and horticultural industries. Hawaii has been too long dependent upon the success of one or two crops. It is realized also that at least one additional agricultural industry should be developed to supplement the sugar-cane and pineapple crops, the leading products, in the event of calamity befalling them. The development of a more complete diversified agricultural program would make possible the utilization of lands which are not adapted to the leading crops. Moreover, it would furnish a variety of activities which would enable persons not wishing to engage in the present major industries to find employment better suited to their liking. Such diversity in the agricultural industries would naturally tend to offset the dangers resulting from labor unrest.

The station is especially interested in fostering the development of the edible-canna industry. The crop is comparatively new in Hawaii, gives promise of adding a starch-producing industry to the islands, and can be grown on thousands of acres of land that are not suited to pineapple and sugar-cane cultivation. Plans have been formulated and experiments started to determine to what extent edible canna can be utilized by the leading agricultural industries, turning the tops under as a green manure and using the rootstocks as a source of commercial starch or as a stock feed. A market has recently been developed for the starch at a price only slightly lower than that prevailing for sugar.

The pigeon pea (*Cajanus indicus*) continues to demonstrate its value as a forage crop, and efforts are being made to develop strains that will mature at the higher elevations throughout the islands. Arrangements have been made with F. G. Krauss, collaborator of the station and agronomist at the University of Hawaii, to visit the Himalaya Mountains for the purpose of obtaining strains of pigeon peas said to grow at these elevations. Such strains will be introduced into Hawaii and hybridized with improved heavy-seeding kinds in the hope of producing a progeny that can be successfully grown at the local higher elevations.

Efforts were also directed toward furthering the banana and avocado industries. An attempt is being made to establish strains of hard-shelled avocados which will be immune to attack by the fruit fly. Because of the fly the fruit in the fresh state is restricted by quarantine regulations from being exported to the United States.

In the horticultural division tests were made with the most promising tropical and subtropical plants, including grapes, avocados, papayas, breadfruit, mangoes, Citrus, litchi, dates, and the Macadamia nut. Approximately 32,500 small plants and packages of seed of various improved varieties were distributed to local growers for trial. The horticulturist again served as chairman of the committee on fruit exhibits at the Territorial fair, which was held from September 25 to October 2, 1926, and as one of the judges of the Star-Bulletin school-garden contests. He also served as chairman of the botanical garden committee of the Pan-Pacific Research Institution.

Agronomic work was directed principally toward the introduction and development of improved field, soiling, and pasture crops upon which the dairy and livestock industries of the islands largely depend. Some progress was made in the ginger-culture experiments having for their object the development of suitable varieties for flavoring locally manufactured ginger ale. Several varieties were tested. Progress was made in the development of a solid-headed strain of lettuce for the lower altitudes where most of the truck gardens are located. The division was able to comply with practically all requests for small lots of seed and planting material of improved pasture grasses and field crops.

The agronomist, in addition to his regular duties, acted as one of the judges in the Maui public-school garden contest; continued to serve as secretary at the poultry show of the Territorial fair in 1926; was appointed chairman of the poultry committee for the Territorial fair to be held August 29 to September 5, 1927; was called upon to appraise a flock of 7,000 White Leghorns; assisted poultrymen in the selection of suitable tracts of land for poultry raising on a large scale; and otherwise devoted as much time as could be spared from the agronomic work of the station to problems arising in connection with the poultry industry. In the early part of the fiscal year he was absent from the station on a visit to the United States, where he made a study of general market problems applicable to Hawaiian conditions.

The chemical division continued to devote a large part of its time to the solution of problems arising in connection with the edible-canna industry. Improved varieties were planted, and studies were made of the insects and fungus diseases attacking the crop, and of



methods of culture, and to learn the best time of harvesting. Attention was also given to numerous problems dealing with the extraction of the starch in the mill and the final preparation for market. Two investigations were completed, one relating to the comparative composition of vegetables grown in Hawaii and on the mainland, and the other to the chemical composition of vegetables of oriental origin.

The extension agent for the island of Hawaii again devoted his energies to various agricultural problems and put producers in touch with the sources of the agricultural information they desired. He also materially assisted in extending the culture of edible canna, distributed locally grown pasture grasses and forage-crop seed, and seedling trees for windbreaks, and rendered excellent service in connection with the boys' and girls' club work, Boy Scout activities, school agricultural fairs, and school-garden contests.

Members of the boys' and girls' clubs in the Territory continue to show increased interest in their work with the introduction of improved programs. Of the 1,401 members enrolled, 76 per cent submitted reports. The activities were carried on in cooperation with the public schools and other Territorial institutions. Improvements were noted in the club records of the third and fourth year club members. Leadership activities were encouraged among the young people who had done club work for three or four years. This fall two 4-H girls from the Pollyanna and the Ivy Clubs are entering a leadership contest which is being fostered by the publishers of a farm journal on the mainland. Club members are submitting letters for publication, telling of their interest in club work and something about Hawaii, in an effort to bring the 4-H clubs of the islands in closer contact with similar clubs on the mainland. Special demonstrations and illustrated lectures were given to interested club groups.

At the Haleakala demonstration farm attention was again given to the development of agricultural practices which are best adapted to local conditions. Some 173 varieties of 81 different kinds of crops were tested. Numerous small lots of planting material were furnished to homesteaders and others for experimental purposes. Additional land was cleared and new fence systems were established.

## REPORT OF THE HORTICULTURAL DIVISION

By W. T. POPE

### MANGOES

Cultural experiments with the mango attracted unusual attention, probably because of the increased demand for good varieties. Among those appearing to hold special promise are the Pirie, Victoria, Whitney, Mulgoa, Number-Nine, Kalihi, Alphonse, and two hybrids, Nos. 3714 and 3715, which were produced at the station. Growers are becoming convinced of the necessity for grafting the trees for the production of choice fruit. Grafted trees assume a low spreading habit, which is of value in locations where protection is needed against strong winds, and they bear at an earlier age, probably because scion material from trees which have passed their

youth is used. Most of the varieties mentioned above have been found to be free from attack by the Mediterranean fruit fly (*Ceratitis capitata*).

At the central station in Honolulu cultural experiments are in progress in two orchards which are located at elevations varying between 60 and 100 feet. The soil in these orchards varies from 2 to 4 feet in depth, is underlain by a somewhat porous tufa rock, and is of similar general composition. The old orchard, located in field C-IV, was started about 1908 and contains 77 trees. During the year the orchard was thoroughly plowed, planted with a cover crop, and pruned. A shortage of water for irrigation, due to the drought prevailing throughout the islands, retarded blossoming, and later frequent showers favored the development of mango blight (*Glæosporium mangiferae*) on the blossoms and young fruit, so that a light crop resulted. On fruit of good size the fungus appears in black splotches which spread down from the stem. Spraying with Bordeaux mixture at blossom time and again when the fruit is forming tend to check the ravages of the pest. Mango trees make their best growth in localities where the wet season is over before blossoming time begins. In the past the orchard has been a valuable source of graft wood, but this season good propagating material was rather hard to get.

The young mango orchard, located in field B-III, was started in November, 1923, and contains 43 trees. The trees are being grown alternately 30 feet apart in three rows so as to form a windbreak on the northeast side of the citrus orchard. The mango tree is more resistant to wind than are most of the other tropical fruit trees in Hawaii. Two years ago the orchard was interplanted with two rows of papayas 8 feet apart between rows of mangoes with tomato plants 4 feet apart in the spaces remaining. The tomatoes were not grown this year, but the papayas are to remain for another season at least. The young mango orchard now contains 14 varieties, most of which are comparatively new and will be of value as a source of propagating material for grafting experiments. The orchard was pruned, sprayed, and cultivated.

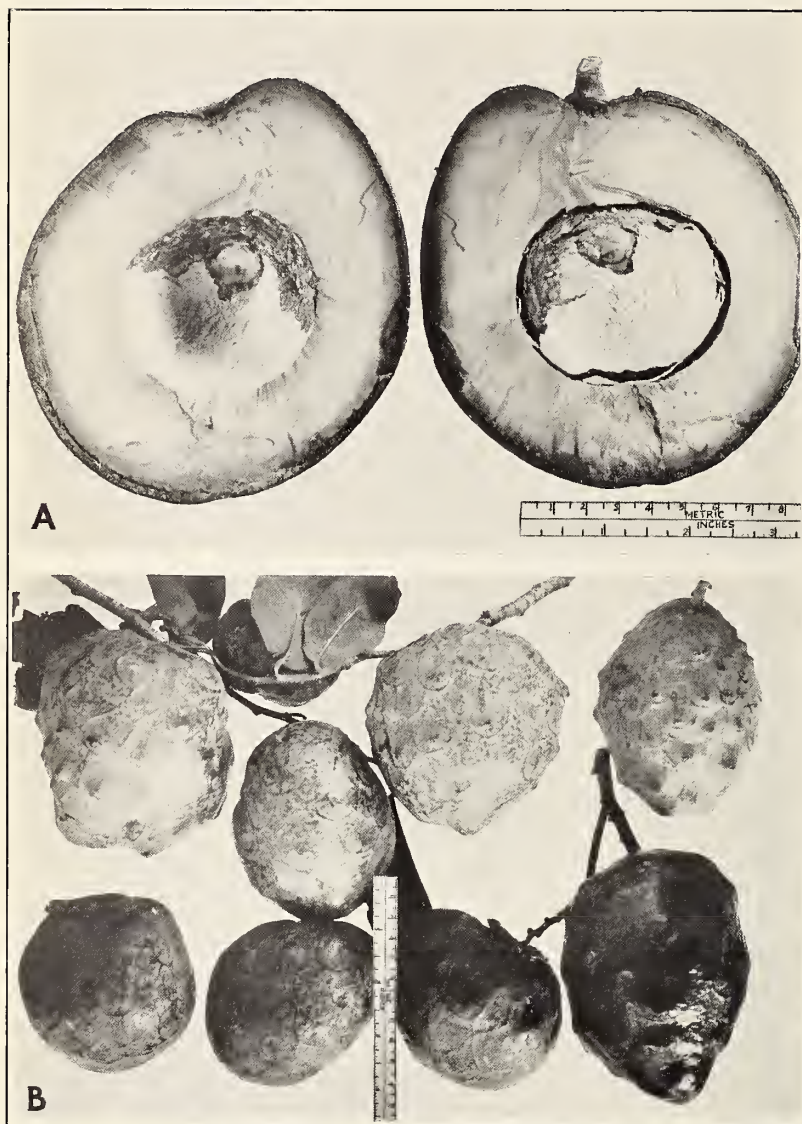
In the mango-propagation experiments seedlings were grown, and several methods of grafting were tried, including side-tongue grafting, wedge grafting, and bark grafting, all of which gave in nearly every instance very gratifying results. Tests with seeds of the Pirie mango, an East Indian variety, were unusually satisfactory presumably because it produces only one plant from each seed. The seedlings apparently are larger and more vigorous than those from the polyembryonic seed of some other varieties often used. This character, however, requires further investigation.

Varieties newly established at the station include the Bishop, Steward, Farrar, Ludwig, Ono, Waterhouse, and Larnach. (Pl. 1, A.) The Larnach, a seedling of unknown origin, was planted in the residence yard of No. 1946 Makiki Street, Honolulu, about 1910. The place became the property of A. D. Larnach about 1920. The tree soon came into fruit and has borne freely nearly every year since. The fruit has attracted considerable attention. On July 12, 1926, specimens were photographed and described at the central station, and the variety was designated station accession No. 5155.





A.—The Larnach mango, a newly established variety at the station. Fruit very attractive and of good flavor. Seed at right. B.—Malaga grapes grown at the station. Scions from California were grafted on Isabella rootstocks



A.—Bountiful avocado, a new hybrid fruiting for the first time in December, 1926. Developed by W. J. Cooper, Haunala, Oahu. B.—Wild seedling cherimoyas, showing variations in the fruit. Weight from  $1\frac{1}{2}$  to 2 pounds; quality good. Introduced into Hawaii early in the nineteenth century

The Larnach mango is very large, has a total weight of  $15\frac{3}{4}$  ounces, and is oblique to round in shape; length from stem to apex,  $3\frac{5}{8}$  inches, width,  $4\frac{1}{2}$  inches, thickness,  $3\frac{1}{4}$  inches; deep depression around stem, the cavity having grooves radiating from the stem; ground color, yellow with bright red over top and over most of the exposed side; rind, thick and leathery; flesh, yellow to light yellow, somewhat fibrous, firm, juicy, with apricot flavor; keeping qualities good.

The station, working in cooperation with interested growers, has been instrumental in establishing nearly 300 grafted trees in the Territory.

#### GRAPES

Experimental work with grapes was largely a continuation of that begun in 1921. The original vineyard of 200 Isabella vines was

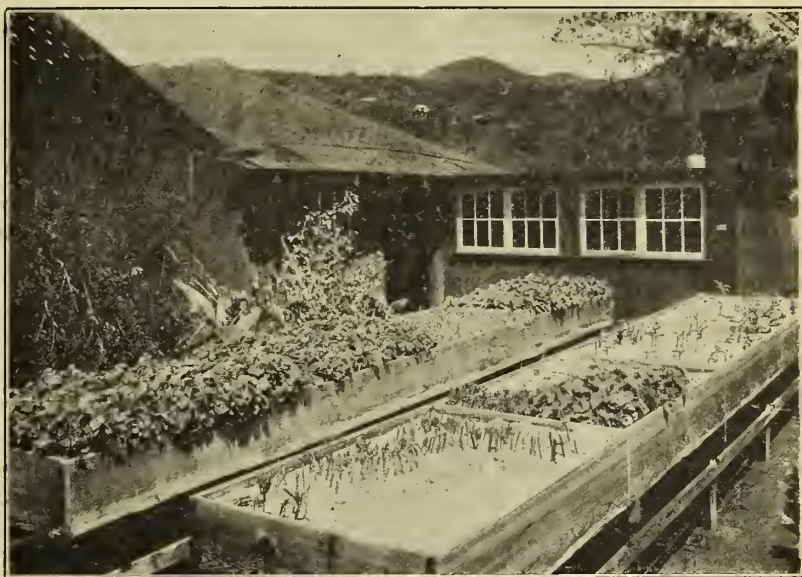


FIG. 1.—Grape cuttings at the station, rooted in large sand boxes in the open. The cuttings were set in the sand immediately following pruning of the vines during the dormant period

maintained as in other years to supply resistant roots upon which to graft other strains and for making cultural tests. Plants of the varieties *Vitis labrusca* and *V. vinifera* which were grafted on Isabella stocks have fruited. The Isabella fruits on its own roots. Two plants of the variety *V. tiliaefolia* (S. P. I. No. 44060), obtained in 1921, have fruited. California varieties which were grown on their own roots have been attacked by nematodes in the soil to such an extent as to suggest the advisability of growing these varieties on Isabella rootstocks. Varieties of recent introduction fruiting for the first time include the Duchess, Malaga (pl. 1. B), Cornichon, and Rose of Peru. Varieties which were introduced from southern California during the year include the Olivette Blanche, Gros Guillaume, and Pierce. These varieties are making good growth and show considerable promise.



An experiment occupying an acre of ground is being carried on in cooperation with a homesteader on Molokai. It is planned to establish the Isabella variety, and after the vines have made several years' growth to top-work a part of them to other good table varieties. Interested growers who are making tests with grapes on a small scale received a limited number of vines, amounting in all to about 600 plants. (Fig. 1.)

Several conclusions have already been reached in connection with the grape experiments. To grow grapes successfully the varieties should be grafted on Isabella rootstocks, and the so-called Japanese beetle (*Adoretus sinicus*) must be kept under control.

#### AVOCADOS

In the cultivation of the avocado in Hawaii probably the most important problem awaiting solution is the development of more effective methods of propagating good varieties. Vegetative methods of propagation have not been so successful with the avocado as with the mango and the Citrus. Last year the greatest success with the avocado was had through wedge grafting, utilizing seedlings 40 to 50 days from date of planting the seeds. This year, at the time some 600 seedlings were ready for wedge grafting, dry weather prevented the development of the young shoots for use as scions. The station orchard is located at the Tantalus substation, where irrigation is not possible. The seedling stock was grafted much later in the season, however, when the wood was larger and harder. Several methods of grafting were employed at different times on seedlings grown from seed in gallon tin containers and varying in height from 1 to 2½ feet. The side-tongue method of grafting was used, the insertion being made a few inches above the soil. In both the wedge-grafting and the bark-grafting methods the seedling was cut off about 5 to 8 inches above the ground. If the scion fails to grow the seedling is lost. With the side-tongue method of propagating avocado trees the seedling survives and may be tried with a new graft in the course of a few days if the scion and the stock fail to unite. In all the unions melted paraffin was found to be of benefit as a protective covering. Amateur nurserymen have experienced difficulty in producing grafted stock of choice varieties. Although a fair percentage of the seedlings in Hawaii tend to produce good fruit for commercial purposes, the standard varieties evidently must be vegetatively propagated.

A few new varieties were added to the cultural test under way at the Tantalus substation, where the elevation is about 1,000 feet and climatic and soil conditions are better than at the central station. The trees are set in terraces. Most of the trees are over 9 years old and with the exception of a few later plantings have already shown the habits and nature of fruit of the particular varieties from which they were grafted. The fruit set the spring of 1927 was abundant and has received ample moisture from the frequent rains to insure maturity. Bountiful (station accession No. 5317) is an excellent new variety of the year. (Pl. 2, A.) The result of a cross between Guatemalan and West Indian, this hybrid fruited in December, 1926, while very young. The tree is very vigorous and prolific and was grown by W. J. Cooper, of Hauula, Oahu.

The Bountiful is large, almost spherical in shape, and weighs 2 pounds; surface, slightly undulated and of a greenish color with slight cast of yellow at maturity; rind, medium to thick; pulp, light greenish yellow, buttery, without fiber; flavor, very good; seed, tight in cavity; weight of seed,  $4\frac{1}{2}$  ounces; weight of rind, 4 ounces.

#### PAPAYAS

The papaya investigations, representing 13 different kinds, were conducted in fields C-II and C-III, which are located in different parts of the station grounds. The papayas are not designated by varietal names since they are not true varieties, but are known by accession numbers. Usually the labels contain a suggestive name also, such as long-fruited type, round-fruited type, Dapitan, Solo, Guam, or Samoa. The seeds were planted in propagating trays filled with coral sand, and the resulting seedlings were transplanted 20 days later to 4-inch containers, where they remained for about 60 days prior to transplanting to the field. The total number of seedling trees set was 214, and the percentage of staminate trees among dioecious kinds averaged little less than 10 per cent. The first fruit to ripen was of dioecious type, round form, and weighed a little over 6 pounds. The fruit was of good quality and matured in 330 days after planting the seed producing the tree.

In another experiment begun in field B-III in 1925 with 185 seedlings from the seeds of one papaya tree, the trees came into bearing in May, 1926, and have been producing almost constantly since. The original tree bore fruit of oblong-oval shape, with flesh of deep crimson color and fine flavor. None of the trees in the experiment have borne fruit of crimson color. Three per cent of the fruits have been pinkish or pale red and the rest yellow to orange.

Young papaya plants which are grown in the open in the full sunlight for 60 to 90 days may be successfully shipped by mail or by freight to distances requiring 10 to 12 days in transit. In preparing plants for shipment the roots should be carefully washed to remove all adhering soil and then packed in dampened (not wet) sphagnum moss. The plants should be wrapped in waxed or oiled paper, including even the sphagnum-covered roots, and then in turn with corrugated pasteboard to maintain the shape of the package, and finally in manila paper of medium weight.

Several cooperative experiments in papaya growing were started, and 14,000 plants from selected stock were distributed throughout the Territory. During the year the station obtained papaya seed from Tahiti, Samoa, and Guam, and from Natal and Tanganyika in Africa.

#### BREADFRUIT

The breadfruit experiment in progress is a continuation of that begun three years ago, and is being carried on in cooperation with G. P. Wilder, of the Bishop Museum staff, who is visiting in the South Sea Islands. In addition to the establishing of improved varieties in Hawaii, studies are being made to determine the best methods of collecting, packing, shipping, and propagating the breadfruit. The propagating material consisted wholly of cuttings taken from the surface roots of seedless varieties. Five consignments of



material have been received to date. The material was assembled at Papeete, Tahiti, Society Islands, and shipped via San Francisco to Honolulu. The roots were in transit from 20 to 30 days and in some instances were out of soil for a much longer period. A report concerning seasonal conditions prevailing at the time collection was made has not as yet been received, but since only a very small percentage of the cuttings rooted and sprouted as compared with the percentage of those received from Samoa last year that rooted and sprouted, it is thought that either the period required for transit is too long for breadfruit or that collection was made during a season when the cuttings could not withstand shipment.

Young seedless breadfruit trees at the station have been successfully propagated from the surface roots of old Hawaiian trees for the past several years. The methods followed in the present experiment were carefully worked out. The propagating bench is located in the insect-proof, glass-covered house where both temperature and moisture can be controlled. A 2-inch layer of loose, rich, sterilized potting soil was placed in the propagating bed and overlain by a 1-inch layer of washed coral sand. The soil was slightly firmed, and the cuttings were placed horizontally and covered with more sand to a depth of 4 inches. This 7-inch medium was then firmed to give close contact between sand and cuttings. From three to five months are required by breadfruit cuttings to develop sprouts and new fibrous roots of sufficient size to permit transplanting from the propagating bed.

The results of the present experiment tend to confirm those obtained in 1923 and 1924. The so-called surface roots must be carefully removed from the soil during the dormant period immediately preceding the renewal of growth. The cuttings should vary from 1 to 1 $\frac{3}{4}$  inches in diameter and be cut in 12-inch lengths for shipping. Prior to planting the cuttings should be sawed in 6-inch lengths and the ends smoothed with a sharp knife.

#### CITRUS FRUITS

Cultural tests with citrus-fruit trees have been in progress at the central station in Honolulu for some years. The work varied little from that of last year. A few new kinds of citrus were added, and the orchard was thoroughly pruned and cultivated. A cover crop of cowpeas is being grown and will be plowed under to improve the soil. The orchard in general has not recovered from the ill effects of the droughts of the last several years. Orange scale, mealybugs, and aphids attacked the trees during the year and were brought under control by spraying and by the recent rains. Tree cockroaches have lately appeared in considerable numbers and damaged the trees by girdling the bark of the twigs. As a control measure tin cans containing a poisoned bait and open only sufficiently to admit the pest have been tied among the twigs.

In connection with the cultural test, attention is directed to the occasional occurrence of abundance of seed in the Washington Navel, Golden Buckeye Navel, and Thomson, varieties of orange which are normally seedless. This phenomenon has also been observed in the Marsh Seedless and the Foster grapefruits, and in the Victoria shaddock. (Pl. 3, A.) The fruiting season extends over several



A.—Victoria shaddock, a pink-fleshed fruit grown at the station. Excellent for salad making. B.—Shaddock seedling, 6 months old. Notice the freak blossom corolla modifications on bracts and parts of true leaves



months, but the seeds were noted only on the fruits ripening during a period of two or three weeks on two occasions during the past six years. The trees grow at no great distance from lemon, lime, orange, and other kinds of citrus trees known to have fertile pollen. Isolated trees of the Victoria shaddock and the navel orange from the same source of grafting material as the above-mentioned trees have not been observed to bear seed-containing fruit.

Another interesting occurrence was the abnormal flowering of young shaddock trees (*Citrus decumana*). (Pl. 3, B.) In a recent experiment with rootstocks, a number of seedlings 10 to 12 inches high began to blossom at about six months of age. All the leaves on the upper part of the stem were in part corolla-like. The lower ones had white margins; higher up, half or more of each leaf was petal-like in structure; and near the flower the entire leafage and the stem were petal-like structures. The flower crowning the stem seemed to be perfect but failed to set fruit.

Citrus-fruit trees have been propagated at the station from seed and by grafting. The seeds were germinated in shallow boxes or flats containing coral sand, and the resulting seedlings were transplanted to containers of sterilized soil. Three hundred seedlings of the Hawaiian orange were grown to permit a study of the amount and kind of variation occurring in the fruit. Seedlings from the seed of the Hawaiian orange generally tend to produce fruit of fairly good quality, but exhibiting some variation. Fifty seeds from the navel orange were germinated to study the development of the seedling into bearing trees.

Other seedlings which were grown for use as propagating material included 28 sweet-shaddock plants, 116 common-shaddock plants, 50 trifoliolate-orange plants, 200 tabog plants, and 378 sour-orange plants. Six hundred lime seedlings were grown for use in cooperative cultural tests.

#### MACADAMIA NUT

Interest in Macadamia-nut culture increased considerably during the year, more because of the results of experiments which are being carried on in cooperation with private growers using 50 or more trees each, than because of the distribution of small numbers of trees for home planting. The seed and trees are in great demand. The station received from Queensland, Australia, a small lot of the seed of two varieties of *Macadamia ternifolia* and seed of *M. prealta*. The nuts of one of the varieties of *M. ternifolia* were large and of comparatively thin shell. All the nuts obtained failed to germinate.

Approximately 800 seedlings were grown from selected Macadamia nuts of the two old trees at the Tantalus substation, and 1,200 seedlings from seed obtained from other sources. About three-fourths of the seedlings were distributed.

The small grove of 50 trees planted at the Tantalus substation in 1921 has grown unusually tall, and the trees have suffered considerably from strong winds. Tall Macadamia trees growing in other parts of the Territory have been similarly affected. The experiments begun three years ago in cooperation with T. C. White, to learn the effect of pruning on Macadamia trees under Kona conditions, are expected to show some interesting results. An inspection of the



plantation of the Hawaii Macadamia Nut Co., where 6,000 Macadamia trees have been planted at different elevations ranging from 1,100 to 2,700 feet, shows that the location is favorable to the culture of this nut.

A mimeographed circular giving information on Macadamia nut culture was prepared for distribution.

#### BANANAS

Investigations made to determine the cultural and commercial possibilities of the banana were completed and the results submitted for publication.<sup>1</sup> Experiments both at the central station in Honolulu and at the Tantalus substation are being continued for the purpose of supplying propagating material for further work and for distribution to interested growers.

Plantings of the Brazilian variety have greatly increased within the last two years. Over 100 additional acres were devoted to the crop on windward Oahu this year. Propagating material of the Bluefields variety is much more abundant than formerly, and the planting of Chinese varieties by regular growers is increasing, probably on account of the unusually good prices which are paid for the fruit in the markets of the Pacific coast. The Hawaiian banana is in greater demand for home consumption than in previous years. This, too, has brought about an extension in the area devoted to the crop, particularly on the island of Hawaii, where the native varieties make their best growth.

#### DATES

The development in various parts of the Territory of date trees bearing fruit of fairly good quality from the seed of fruit which was purchased in the local markets has stimulated interest in date growing. Among the introductions of the year from the Indio experiment station, Indio, Calif., were 100 each of the varieties Deglet Noor and Maktoom, and 50 each of the varieties Manakhir, Tazizaoot, Saidy, Barhi, Khalasa, Zehedy, Halawy, Thoory, and Deglet Noor-Canariensis hybrids.

#### COFFEE

Some investigations were carried on with coffee, and notes from publications and many references were collected. A survey of the coffee situation in the district of Kona, Hawaii, was made during one week of August, 1926. Material is now being collected and methods are being outlined for an experiment which it is hoped may be started early in the fiscal year, 1928.

A few coffee trees of *Coffea arabica* and *C. robusta*, which were planted at the Tantalus substation about 1902 and 1903, produced light crops during the year. Some 1,200 young plants are now growing from the seeds of *C. arabica* which were obtained from the Tantalus substation trees. Seeds were also distributed to cooperative growers desiring to grow coffee on a small scale. Coffee seeds which were planted in January, 1927, in flats containing a mixture of soil and coral sand produced seedlings which reached suitable

<sup>1</sup> POPE, W. T. BANANA CULTURE IN HAWAII. Hawaii Agr. Expt. Sta. Bul. 55, 48 p., illus. 1926.



size for transplanting to pots in April. Sample packages of *C. arabica*, *C. buxobensis*, *C. excelsa*, *C. liberica*, *C. quilloa*, and *C. robusta* were sent to the station for trial by R. T. Rogers, head gardener of the Amani Research Institute, Amani, Tanganyika Territory, Africa.

The six varieties on arrival were held by the Bureau of Plant Inspection in Honolulu, and later forwarded to the Bureau of Plant Industry, United States Department of Agriculture, at Washington, D. C., where they are to be grown in quarantine.

Coffee investigations in Kona showed that most of the lands under cultivation by small growers are leased from large landowners. In many cases the leases cover a period of 10 years or longer, and some of the landowners are not interested in either the welfare of the small grower or the coffee industry. In most cases the growers know very little concerning agricultural practices in general and practically nothing concerning coffee growing in particular. They seldom come in contact with agricultural experts, and some of them are inclined to look upon offers of assistance with suspicion. The coffee trees are sometimes badly infested with aphids, and little effort is made to control the pest; growers remove crops year after year with little attempt to maintain soil fertility; fields or parts of fields are abandoned presumably because of poor yields, and coffee growers are found devoting most of their time to other activities. Considerable areas of land which are not now utilized for crop production could be profitably planted with coffee. Thousands of acres of land in Kona alone are overgrown with guava bushes and should be cleared for coffee production. The area is admirably adapted to coffee. The country slopes to the westward, with high mountains in the east and northeast which afford shelter from the prevailing trade winds. The rainfall is abundant and is peculiarly regulated by the mountain formations. The so-called rainy season occurs from May to September, which is also the season of highest temperature. The clouds form in the early afternoon, and the rain begins about 3 or 4 o'clock and continues without wind into the night. The formation of clouds during the time of day when the sun is hottest affords a natural protection for coffee trees, which in most places must be shielded against the sun's rays by the interplanting of shade trees. The coffee plant is rather delicate in its relation to extreme temperatures in the Hawaiian Islands. The soil of Kona is a rich lava which overlies a coarse stratum permitting the excellent underdrainage so essential for coffee growing.

These favorable conditions have demonstrated their value for the production of coffee of high grade in Kona. A consideration of the conditions and also of the comparatively high prices paid to growers for the crop should serve to encourage interested growers to pursue a scientific study to improve the industry and follow agricultural methods permitting the most profitable production of coffee. Plans have been made for cooperative work in Kona for the purpose of investigating the coffee and such other agricultural crops as may be found adapted to the region.

#### FIGS

Fig experiments were confined to cultural tests and the propagation of new plants from cuttings. The four varieties of figs which are growing in the station orchard fruited heavily, particularly the

Kadota which has proved to be a prolific bearer in Hawaii. Most of the propagating material used in the experiments was from prunings which were obtained from cooperative growers. About 600 fig cuttings were rooted and distributed.

#### CHERIMOYA

In Hawaii the cherimoya (*Annona cherimola*) grows at elevations above 1,000 feet where the climate is cool and comparatively dry during the greater part of the year. Such conditions are to be found in parts of the islands of Maui and Hawaii. In Hawaii the cherimoya now grows wild as a part of the natural vegetation. Some 200 seedlings were grown from the seed of selected fruits which were collected from the Kona district. Many of these seedlings were distributed to interested growers. It is planned to conduct certain grafting experiments, using scions from trees of unusual quality, in the hope of establishing standard varieties for localities which are adapted to cherimoya culture. The cherimoya should find a ready local market if the fruit is produced in reasonable quantities. (Pl. 2, B.)

#### MULBERRY

There is constant demand for the black mulberry which has been in cultivation in Hawaii for many years. The tree is a prolific bearer and is easily propagated from cuttings. Some 2,000 cuttings were distributed.

#### ROSELLE

The roselle is considerably in demand for jam and jelly making. New seeds of two varieties which were obtained two years ago have been propagated. Approximately 2,000 plants of the roselle were distributed during the year.

#### MISCELLANEOUS NOTES

Other economic plants receiving attention included the litchi, star apple, tomato, mountain apple, carambola, chestnut, pecan, sapodilla, cashew, guava, pitanga, carissa, Brazilian cherry, sea grape, soursop, tree tomato, watermelon, granadilla, and Pejibaye palm.

One hundred and seventy-six introductions, consisting principally of seeds, cuttings, and rooted plants, from various parts of the world were made during the year. The more important introductions included grapes (3 varieties), dates (11 varieties), mangoes, coconuts, breadfruit varieties from the South Seas, and a superior variety of pecan from Georgia.

Approximately 32,500 new and improved plants, packets of seeds, cuttings, graft wood, and rooted plants were distributed, including 400 grafted trees of new varieties of avocados, mangoes, and Citrus varieties.

Cooperative experiments were conducted in the Macadamia nut groves of C. T. White, Kealakekua, Hawaii, W. L. Hopper, Wahiawa, Oahu, and R. J. H. Farrar, Pupukeya, Oahu; the avocado orchards of C. Miller, Kaneohe, Oahu, and D. S. Bowman, Kona, Hawaii; the mango and avocado orchards of W. J. Cooper, Hauula, Oahu; the

papaya groves of D. C. Pak, Palolo Valley, Oahu, E. Y. Chang, Kaalaeu, Oahu, and T. Okomoto, Waialae, Oahu; the grape vineyard of G. Nihoa, Molokai; the date garden of E. P. Fogarty, Waiahae, Oahu; and in connection with banana and other fruit growing by Charles Dole, Kapaa, Kauai.

The larger cooperative experiments constitute an endeavor to assist interested persons to get a start in the fruit-growing industry. The horticultural department responded to many requests for information from growers, prepared for distribution mimeographed circulars on the roselle, the Macadamia nut, and insect-pest control, and gave horticultural demonstrations to classes and other interested groups. The horticulturist acted as judge in the Oahu school-garden contest of 22 schools and 290 home gardens. He made three trips to each garden during the spring. The schools made a creditable exhibit of fruits and vegetables at the Pan-Pacific Conferences on Education, Reclamation, and Recreation, which were held in April, 1927.

## REPORT OF THE AGRONOMY DIVISION

By H. L. CHUNG

### EDIBLE CANNA

In view of the potential importance of edible canna as a commercial source of starch in Hawaii, a further effort was made to increase production by selecting the best hills for seed and to develop good varieties by cross-breeding. Two interesting and promising hybrids were found among the seedlings resulting from crosses made last year. One has green corms in striking contrast with the corms of the parent which are purple. A large area has been planted with seedlings of the two hybrids, both at the station and at the Haleakala demonstration farm on Maui.

An investigation was made to determine the most practical method of treating the hard coat of the canna seed prior to planting in order to hasten germination. Ordinarily the seed is filed to scarify it, but the method is slow and laborious. Commercial sulphuric acid was therefore used to soften the seed coat.

### SWEET POTATOES

The sweet-potato seedlings and a number of standard varieties were subjected to a rigorous culling test, and only the best were retained for further breeding work. The flower-bearing varieties were studied to determine the relation of blooming to productivity and earliness. The results of preliminary tests fail to show that blooming affects either productivity or earliness.

### TARO

A cultural and variety test was made to determine the comparative yields and keeping qualities of a Samoan variety and a number of choice Hawaiian varieties of taro. Tests were also made with three varieties of dry-land taro which represent the best obtainable in the local market and find a ready market on the mainland. The



varieties of upland taro give promise of becoming a valuable crop for Hawaii.

#### WHITE POTATOES

An extensive potato-planting experiment was started in cooperation with growers in the Palolo Valley, but the crop was a failure, on account of heavy rains and wind. It is planned to repeat the experiment in the fall of 1927.

#### GINGER

The ginger plantings were also destroyed by heavy rains and by insect pests. The station has encouraged the growing of this crop to meet the demand for island-grown ginger for use in the manufacture of ginger ale.

#### CORN

A preliminary study was made of the Guam corn hybrids, and an attempt was made to establish varieties having sturdy, heavy ear-bearing stalks and other outstanding characters. Encouraging results were had in the work of improving the varieties of Guam, Cuban Red, and sweet corn.

#### SORGHUM

The past year was very favorable for the growing of grain sorghums, and was conspicuous by the absence of insect pests. Seedlings from seed taken from plants which grew in the agronomy field under adverse conditions made remarkable stands.

#### LETTUCE BREEDING

Approximately 220 crosses were made in the lettuce-breeding work. Some very interesting and promising individual head-lettuce plants have been produced. An attempt is being made to establish varieties having desirable characters.

#### FORAGE GRASSES

Fourteen species of forage grasses were successfully maintained in the demonstration plats and the yields were recorded at each harvest. Propagating material from the areas was distributed to ranchmen and to dairymen who are interested in the grasses.

#### EDIBLE-POD PEA

Three varieties of edible-pod pea were obtained by the junior agronomist and grown to compare their adaptability, quality, and yield with a local established variety. Of the three, one promises to be outstanding. Edible-pod pea is regarded as a luxury in the local market, and usually retails at 65 cents per pound.

#### PLANTING WINDBREAKS

Many inquiries for information concerning the varieties suitable for temporary windbreaks were received from homesteaders in

localities where the winds damage the crops. The agronomist recommended the *Crotalaria usaramænsis* and the pigeon pea for the purpose. Napier grass, Uba cane, sunn hemp, and panax hedge were grown in an experiment to determine their relative desirability as windbreaks and their rate of growth.

#### NEMATODE CONTROL

A part of the agronomy field which was found to be infested with nematodes was planted with tomato plants for use as indicators of the amount of infestation, and with tobacco plants to determine their toxic effects upon the worms. The effect of the tobacco plants upon yield of tomatoes was also noted.

#### SEED FUMIGANTS

Moth balls were used on a large scale as an effective fumigant, and a test with moth balls and carbon bisulphide was made comparing their effectiveness, cost, and ease of handling.

Records are kept of the ages of all seed produced at the station, and notes are made concerning the rate of deterioration.

#### DISTRIBUTION OF SEEDS AND CUTTINGS

Distribution of seeds and cuttings from July 1, 1926, to June 30, 1927, was made in amounts as shown in Table 1.

TABLE 1.—Seeds and cuttings distributed during the fiscal year ended June 30, 1927

Crop	Seed	Cuttings	Crop	Seed	Cuttings
	Pounds	Number		Pounds	Number
Alfalfa.....	15	-----	Pigeon peas.....	20	-----
Beans.....	170	-----	Spinach.....	4	-----
Jack beans.....	4	-----	Sunflower.....	1	-----
Mungo beans.....	4	-----	Sunn hemp.....	12	-----
Velvet beans.....	16	-----	Jerusalem artichokes.....	-----	60
Chinese cabbage.....	1	-----	Cassava.....	-----	200
Guam corn.....	200	-----	Edible canna tubers.....	-----	350
Sweet corn.....	50	-----	Ginger.....	-----	50
Cowpeas.....	40	-----	Grasses.....	-----	9,500
Grasses.....	4	-----	Napier grass.....	-----	24,000
Lettuce.....	6	-----	Potatoes.....	-----	20
Melons.....	3	-----	Sweet potatoes.....	-----	6,000
Peanuts.....	90	-----	Uba cane.....	-----	2,800

### REPORT OF THE CHEMICAL DIVISION

By J. C. RIPPERTON

#### EDIBLE-CANNA INVESTIGATIONS

Progress was made in the commercial development of the edible-canna starch industry notwithstanding the drawbacks incident to the establishment of the new industry. The exceptional yields and hardiness of the crop, particularly in the Waimea district, lend encouragement to the belief that the crop will ultimately be established upon a firm basis.

Correspondence was carried on with growers in various parts of the Tropics and sub-Tropics to learn to what extent edible canna



is grown in these parts of the world. From Queensland, Australia, it was reported that the principal canna-producing area is at 27° south latitude and that the crop is not grown any nearer the Equator than 15° south latitude. Hawaii lies between 19° and 23° north latitude.

Under tropical conditions such as exist in Java, the canna has been abandoned in favor of the higher-yielding cassava. In the continental United States small plantings in Florida showed little promise. The average yield in Queensland, where edible canna has been grown for starch for nearly 50 years, is not over 10 tons in 12 months. Under the ideal conditions existing in Waimea, Hawaii, the crop usually yields 30 tons per acre in 15 months. It is felt, therefore, that edible canna is unusually well adapted to the climate of the Hawaiian Islands and should be able to compete



FIG. 2.—A 35-pound hill of edible-canna rootstocks grown at Laupahoehoe, Hawaii

successfully on the market with edible-canna starch from other countries.

Considerable interest is being shown in the possible utilization of edible canna by the established agricultural industries of the Territory. If the top growth of the plant can be used as a green manure in pineapple culture and the rootstocks for starch or as a stock feed the crop might profitably be grown in rotation with pineapples. The possibility of growing edible canna on pineapple wilt-infested areas or on lands that are not adapted to the pineapple or sugarcane crops is under consideration. Edible canna would seem to be especially desirable for homesteaders in the Waimea district, because the crop as a starch-producing plant can readily be converted into cash, and it can also be used as a feed for stock. The station is endeavoring to stress the advisability of adding to the Territory a third agricultural industry which can be rapidly expanded in the

event of failure overtaking either of the two leading industries. (Figs. 2 and 3.)

#### FIELD EXPERIMENTS

An experiment occupying half an acre of land was established in Waimea in August, 1926, to study problems of improvement in the strain through seedlings, hybridization, mass selection, and mutation. The work is being extended for the purpose of determining the effect of seed selection on resulting seedlings and the best cultural practices for the plant; of testing a number of introduced varieties to learn their adaptability to Hawaiian conditions; of finding the cause of and the remedy for the appearance of diseased and abnormal plants in an otherwise sound field; and of studying the methods of growth of the canna plant.

Harvesting in the fertilized experimental plats begun in October, 1924, was deferred, due to difficulties in the milling process. Monthly



FIG. 3.—A typical example of an abandoned homestead area, Ahualoa, Hawaii. Part of this land seems to be well adapted to edible-canna growing

harvests of 0.1-acre plats of one-seed and two-seed plantings were begun at the tenth month. The experiment has for its purpose the determination of the progressive increments in yields of rootstocks and the best age at which to harvest the crop. A systematic study of the growth in the field by the classification method is being conducted in connection with the harvests. To determine the progressive increase in the starch content of the rootstocks, specific-gravity measurements on the rootstocks were made from time to time. In this experiment, as in previous experiments, the yields were unusually high. The crop when harvested at the end of the fourteenth month was found to have produced at the rate of 33 tons of rootstocks per acre.

At the central station in Honolulu an experiment was begun to study the growth of the plant in the greenhouse under more carefully controlled conditions than is possible in the field. Progressive growth of the plants is being recorded by means of tags which are

attached to each spike and stalk as they appear. A small area at the Tantalus substation, where climatic and soil conditions are well adapted to the growing of edible canna, was planted, and growth is being studied by biweekly tagging of the newly developed stalks.

In the agronomy field a continuous experiment in hill selection was begun. Two tubers were selected from each individual hill for planting, one being a first-generation rootstock and the other an immature rootstock of the fifth or sixth generation. It is planned to repeat the process twice, making a total of three plantings, before hill selection is begun. Planting stock from Porto Rico and from Queensland, Australia, was received and planted, and arrangements were made to obtain stock from the wild species in Peru, where the canna plant is said to have originated.

#### MANUFACTURING PROCESS

The chemist and the extension agent for the island of Hawaii spent two weeks investigating the process of manufacture of edible-canna starch at a factory in Waimea, Hawaii. The manufactured product was excellent in quality, but the method used showed a number of defects. A report concerning the defects and suggested remedies for them was submitted to the company. It was pointed out that the manufacture of edible-canna starch is different from that of other starches in at least two respects. One concerns the washing process and the other the fibrous nature of the rootstocks. The long roots, dead scales, and cracked surface of the rootstocks make it extremely difficult to cleanse them of adhering soil. The shredded pulp of the edible canna is light and fluffy, whereas the pulps of the potato and the cassava resemble a sludge. When the light pulp of the canna is thrown on the extraction screens the excess water runs through quickly and leaves the pulp comparatively dry. With the denser pulps of the potato and the cassava, however, the water passes through the screens much more slowly. Extraction is very incomplete in the first instance, whereas it continues throughout the length of the screen in the second. Starch-extraction methods will have to be modified somewhat for edible canna before they can be expected to give satisfactory results. The manufacturing concern was advised to purchase a standard potato shredder because the present machinery results in only incomplete rupturing of the cell structure of the rootstocks, which is one of the principal causes of low extraction. Correspondence was carried on with a number of manufacturers of starch-extraction machinery in Germany and France in the hope of eventually having introduced into Hawaii up-to-date machinery which will be more effective in overcoming the difficulties incident to starch manufacture than are the locally manufactured machines.

#### MILL-CONTROL METHODS

Some beginning was made in the establishment of a system for control in the milling process. An adaptation of the procedure used in sugar-mill control was worked out to determine the extraction. Determination of the starch content of the incoming rootstocks by the specific-gravity method seems to be feasible for the purpose.



The so-called "spot test," which was developed by the station, promises to be particularly useful in the refining process. By this "spot test" method a weighed portion of the wet starch undergoing refinement is hydrolyzed and the particles of soil and darkened tissue settling out are collected on a disk of filter paper. Inspection of these disks indicates definitely and promptly when the refining process has gone far enough. A rapid method of determining the moisture content of starch in the drier has been developed and found useful.

#### STARCH-EVALUATION METHODS

Study was continued of the methods of determining the viscosity of the finished product, and the methods previously developed were considerably changed, particularly in regard to temperature and to time of cooking. The temperature of cooking was reduced from 90° or 95° C. to 80° and the time from 30 minutes to 15 minutes. Prolonged cooking at higher temperatures caused uncertain losses in viscosity. These changes, coupled with certain refinements in technic, should make the method dependable. The Saybold standard viscosimeter, the MacMichael viscosimeter, and a simple pipette viscosimeter devised by the station for the purpose, are among the instruments being tested for viscosity determination.

A modification of the previously described "spot test" has proved to be adapted for use in starch evaluation. The test consists in hydrolyzing a weighed portion of the dry starch which is ready for shipment. The soil and the dark tissue are collected on a hardened filter paper. After being dried, the particles are mounted with balsam on a microscopic slide. The slide forms a permanent record of the shipment and permits comparison with a "spot range" so that the lot can be graded according to purity. Chemical methods for determining such impurities as protein, ash, and fiber have been outlined, but will hardly be needed in actual practice.

#### SOME FACTORS AFFECTING THE PROPERTIES OF CANNA STARCH

Work begun in 1926 to determine the effect of various factors on the properties of canna starch was continued, and conclusions of immediate value to the industry have been reached. Even extreme variations in the amount of rainfall were found to have little effect on the starch. Age has little effect so long as the rootstocks have not begun to deteriorate. With deterioration in the older rootstocks a loss in viscosity occurs in the starch, and climate has a decided effect. Starch from rootstocks grown at Waimea was decidedly higher in viscosity than starch from rootstocks grown at the central station in Honolulu. The fact that storage of the rootstocks, even for as short a time as 48 hours, reduced viscosity, showed that delays in the milling process should be avoided.

#### PRESERVATION OF HAWAIIAN FRUITS

The chemical division continued to work in cooperation with the small fruit preserving concerns on the different islands. One of the problems of the small producer is how to secure a steady supply of fruit throughout the year without having to maintain an expensive

reserve of glassware and finished jelly. The uncertainty of the system with respect to guavas led to a study of the practicability on a factory scale of storing the extracted juice in 1 and 5 gallon containers. No difficulty was experienced in preserving the juice, and preservation is expected to be less expensive than buying the fresh fruit the year around, due to lower prices prevailing during the culmination of the guava season.

#### COMPOSITION OF HAWAIIAN-GROWN VEGETABLES

Analysis was completed of the second crop of vegetables grown on the mainland (Arlington, Va.), and in Hawaii (Mokuleia, windward Oahu, and Honolulu). Comparison of the results of the analyses of the first and second crops showed only few consistent variations which can be attributed to differences in climate or soil. However, results of the experiment, together with the analyses of a series of some 60 fresh vegetables which were grown in Hawaii, prove that locally grown vegetables compare favorably in their mineral constituents with similar varieties grown on the mainland.

#### REPORT OF HALEAKALA SUBSTATION AND DEMONSTRATION FARM

By H. F. WILLEY

At the Haleakala substation and demonstration farm 75 rods of new fence were constructed and 70 rods of old fence rebuilt. All line and cross fences were maintained in good condition. Clearing of the gulch land for pasture was continued, although greatly handicapped by the aggressiveness of the native shrubby vegetation. About four acres of pasture land was put under cultivation as a part of a general rotation scheme. Some 173 varieties of 81 different species of crops were under test to learn their adaptability to local conditions, including pigeon peas, edible canna, dry-land taro, field corn, sweet corn, pop corn, forage and pasture grasses, and numerous kinds of vegetables and fruits. Distributions were made of over 5,000 rootstocks of edible canna, 450 strawberry plants, 6,000 cuttings of sweet potatoes, and 10,000 cuttings of Uba cane. In addition to 20,000 cuttings of Merker grass and Napier grass, nineteen 1½-ton truck loads of these cuttings were distributed to interested persons desiring to make plantings on a large scale. The farm now supports 1 registered Holstein bull for community service, 3 cows, 2 heifers, 4 calves, 5 hogs, 2 mules, 1 saddle pony, 80 laying hens, and 75 young chickens. One of the Holstein cows gave 308 pounds of milk in three days. (Fig. 4.) Her bull calf is being reserved for breeding.

The superintendent assisted with the boys' and girls' club work, organized eight home and school-garden clubs, and obtained a total of 150 enrollments. Of these, 139 completed their work. He visited each of the 139 gardens twice each month during the school year, traveled 3,225 miles in connection with this part of extension work, prepared special exhibits for both the county and Territorial fairs, and assisted in arousing interest in the fairs and in judging the



exhibits. The superintendent also served as committeeman in connection with the Maui County Chamber of Commerce in the interest of all lines of agricultural extension. He assisted not only in marketing farm products, but also in obtaining the best seed and other planting material of crops desired by the various homesteaders. He made a trip to the island of Molokai and spent several days among the homesteaders who are operating under the Hawaiian Homes Commission.

For the first time in the history of the experimental work of the station, a severe hailstorm occurred and considerably damaged the growing crops. In addition to the hail, which was accompanied by a high wind, 2.3 inches of rain fell in the 30 minutes the storm lasted. The hail drifted in places to a depth of 18 inches and re-



FIG. 4.—Holstein cow with record of over 100 pounds of milk per day for three days, Haleakala substation

mained unmelted throughout the day, although the thermometer recorded a maximum temperature of 64° F. The elevation of the station is 2,100 feet.

## REPORT OF EXTENSION AND DEMONSTRATION WORK ON THE ISLAND OF HAWAII

By R. A. GOFF

### VISITS TO HOMESTEADERS

The extension agent made trips as often and as regularly as possible to the various districts of the island for the purpose of assisting homesteaders and others who are interested in the culture of diversified crops. He made recommendations regarding the kind of rations and crops to be fed livestock, gave advice on poultry culling, suggested remedies for the cure of certain poultry diseases, prepared plans for livestock buildings, gave demonstrations of the proper methods of spraying trees, outlined methods of fruit-tree planting in orchards and vegetable gardening, and otherwise materially assisted in solving farm problems.

### EDIBLE CANNA

Waimea, although an ideal locality for the production of certain crops, is not adapted to the pineapple and sugar-cane crops upon which the economic prosperity of the Territory now depends. The district has a windy, moist climate, lies 2,600 feet above sea level and just below the frost line in winter, and is capable of producing from 30 to 40 tons of edible canna per acre in 15 to 18 months. Thousands of acres of land in Waimea are now devoted wholly to grazing. These should be put under cultivation with edible canna to form the basis of a starch-producing industry. The homesteaders are anxious for the local establishment of some industry which will enable them to market their produce readily. A small starch-extracting mill has been erected, and some 150 acres of land adjoining the homesteads have been planted with edible canna. The extension agent, working in cooperation with the chemical division, has made a number of field experiments dealing with the best time for applying fertilizers and for harvesting, tuber selection for planting, and the best method of planting in an effort to aid the industry in every possible way. Both homesteaders and members of the mill company are interested in the work under way. More than 12 acres of land are included in the experimental plats. Small areas have been planted in other districts in order that it may be learned what localities are best suited to canna production. The plats will be harvested this summer.

### FARMERS' MEETINGS

Talks and demonstrations were given to interested groups of homesteaders on proper methods of pruning, budding, spraying, butter making, applying fertilizers, and growing and marketing crops.

### MARKETS

Homesteaders in outlying districts have difficulty in finding a market for their corn, potatoes, fruit, and poultry products. Careful study was therefore made of the market requirements and to learn what time the produce would be ready for market. Arrangements were made in advance with local merchants to supply the local market and to cancel part of their orders with commission merchants on the coast. This willingness on the part of the resident dealers to buy home-grown products when the proper arrangements are made should encourage local producers to devote increased areas to their crops and to keep in closer touch with the local merchants than they now do. Demonstrations of grading and sorting fruit and potatoes were made with a view to obtaining better prices for the products.

### DEMONSTRATION PLATS

Small plantings of pasture grasses and forage crops were maintained at the schools on both sides of the island. Stakes bearing the names of the crops were placed in each plat to aid the pupils in familiarizing themselves with the names and the habits of growth of crops which are best adapted to the several localities. The plats form a source of supply of seeds and cuttings for neighboring farmers.

## KAMUELA-GRASS PLATS

Plantings of range grasses and forage crops occupying approximately a quarter-acre plat were maintained on an area of land formerly devoted to experimental work in cooperation with the Parker ranch. *Paspalum notatum*, *P. larranagai*, *Phalaris bulbosa*, *Exophorus unisetus*, *Panicum antidotale*, Rhodes grass, Napier grass, Merker grass, Peruvian winter grass, carpet grass, tall fescue, Uba cane, kudzu, sweet clover, and pigeon peas seem to be the best of the crops originally planted. Cuttings and seed of the plants were distributed to farmers in different parts of the island.

## BOYS' AND GIRLS' CLUBS

Garden clubs, livestock clubs, canning clubs, bread-making clubs, sewing clubs, and home-improvement clubs were organized in the public schools on the island of Hawaii during the year. Club meetings were held, and assistance was given to local club leaders. Record books, Farmers' Bulletins of the United States Department of Agriculture, and other pamphlets of agricultural interest were distributed to members. Vegetables and corn seed also were distributed, and seed potatoes and livestock were obtained for members of the boys' clubs. Assistance was given in obtaining necessary material and equipment for members of the girls' clubs. The projects were inspected at the homes of members, where suggestions and encouragement were given to stimulate interest in the work. Club members exhibited their work at school fairs and at the county school fair.

## SCHOOL AND HOME-GARDEN WORK

The extension agent acted as one of the judges in the home and school-garden contests in the Hamakua, North Hilo, and South Hilo districts. He frequently visited the schools and gave talks to the young gardeners concerning the adaptability of the different vegetable varieties to the various localities. He also gave advice regarding fertilizers and methods of planting and of combating plant diseases and pests. Similar work was carried on with individual gardeners, and visits were made to their homes, where garden problems were discussed and suggestions were given on record keeping.

## HAWAII SCHOOL FAIR

The extension agent served on the committee of the agricultural section of the Hawaii school fair, which was held in Hilo in May, 1927. Vegetables from home and school gardens, livestock which was raised by members of the boys' clubs, and articles of clothing made by members of the girls' clubs were exhibited. In addition to aiding in making entries and arranging the displays, the extension agent assisted the members in bringing the exhibits to and from the fair. In connection with the vegetable exhibits he gave timely suggestions regarding the selection of seed of improved varieties and the proper methods of planting. He also assisted in conducting a quick-bread making contest which was participated in by teams from three of the girls' clubs. A trip to the forthcoming Territorial fair in Honolulu will be awarded the girls winning the contest.



**ASSISTANCE IN BOY SCOUT ACTIVITIES**

The extension agent again served as scout commissioner, as member of the traveling court of honor, and as special examiner for boys qualifying for agricultural merit badges.

**PLANTING WINDBREAKS**

Seedling trees suitable for windbreaks were distributed to farmers in the Kohala and Hamakua districts, where strong winds blow during a large part of the year. The trees are grown at the local nursery of the Board of Agriculture and Forestry and are taken by the extension agent to homesteaders living in remote parts of the island.

**ASSISTANCE IN PLANTING FRUIT TREES**

Seedlings on which were budded choice varieties of fruit, including the winter-bearing avocado, orange, lemon, and grapefruit, were distributed to growers in different parts of the island. Bud wood was given to agricultural instructors of the high schools, at two of which demonstrations in budding and grafting were conducted. Bud wood was also given to a number of homesteaders, and small seedling trees were budded in sections of the homesteads where they are to remain permanently. Seeds of the Solo papaya and suckers of the Chinese, Bluefields, and Hawaii cooking varieties of banana were also given to interested growers.

**DISTRIBUTION OF SEED**

Alfalfa and pigeon pea seed was distributed to livestock club members and also to schools for use in planting the summer gardens. Seed, cuttings, and roots from the Kamuela grass plats were distributed to livestock producers in all parts of the island. Waimea corn, imported Boone County White corn, and Hamakua Hybrid seed potatoes were taken to a number of schools and to homesteaders. Extra copies of seed catalogs were distributed on the trips, and assistance was given in selecting and purchasing seed of the varieties best adapted to the soils and climates of the different localities and to the needs of the individual farmers.

**DISTRIBUTION OF LITERATURE**

Newspapers and magazines containing interesting articles on agricultural subjects were loaned to various farmers, and bulletins published by the station and by the United States Department of Agriculture were distributed. Bulletins pertaining to agricultural topics were ordered through the station from the Department of Agriculture for use in the classrooms of teachers of agriculture at the junior and senior high schools.

**REPORT OF BOYS' AND GIRLS' CLUB WORK**

By MABEL GREENE

**STANDARD CLUBS**

Interest increased in the work of the boys' and girls' 4-H standard clubs, and many new enrollments were secured on the islands of Oahu, Maui, Hawaii, and Kauai. New communities have become



interested on each of the islands except on Hawaii, where club activities were carried on with about the same number of enrollments as in 1926. Intensified programs were developed during the year, and additional rural communities in Oahu were reached.

The distribution of the boys' and girls' 4-H standard clubs of the islands is shown in Table 2.

TABLE 2.—*Enrollment of boys' and girls' clubs June 30, 1927*

Club	Distribution				Total
	Oahu	Maui	Hawaii	Kauai	
Canning.....	32	20	43	0	95
Clothing.....	312	122	182	44	660
Room improvement.....	1	0	6	0	7
Cooking.....	80	40	40	0	160
Garden.....	68	123	102	54	347
Pig.....	30	20	3	0	53
Poultry.....	42	0	14	0	56
Rabbit.....	0	5	18	0	23

Club activities were carried on in cooperation principally with the public schools and the International Institute of Honolulu, where organized 4-H club groups had definite programs of work. However, much interest in the demonstrational work of the clubs was shown by other institutions also. Five demonstrations in the proper methods of canning were given at the station to nearly 100 students of the department of home economics of the Territorial normal school. Demonstrations in cooking, preserving perishable food products, and sewing were given by the club leaders in five different communities in Honolulu in cooperation with the Columbus welfare work. The work covered a period of six months, one-half day each week being devoted to each project. Demonstrational work in making guavalets<sup>2</sup> and wearing apparel was conducted for the benefit of interested groups of Girl Reserves and members of the local Young Women's Christian Association.

#### FAIRS AND DEMONSTRATIONS

Many of the boys and girls of the 4-H standard clubs displayed exhibits and gave demonstrations at the Territorial fair. A large area in the agricultural building was allotted club exhibits, including garden crops, poultry, cooked products, canned fruits, jellies, and articles of clothing. Members of the fair commission cooperated in club activities by awarding ribbons and cash prizes to the young winners of the various contests, and this has been the means of fostering interest in the forthcoming Territorial fair. Members of the McKinley Poultry Club conducted a demonstration entitled "Poultry Feeds and Feeding," members of the Kaimuki Poultry Club, demonstrations entitled "Setting a Broody Hen" and "Setting Up an Incubator," and members of the Lincoln Poultry Boosters' team, a demonstration on "Culling for Egg Production." Considerable interest was aroused in contests in yeast-bread and quick-bread making, canning and cooking and serving vegetables, and "good buymanship."

<sup>2</sup> Confectionery made from the guava fruit.

A contest in quick-bread making was conducted at the Hilo school fair, held May 20 and May 21, 1927, with three teams of two 4-H club girls each from Honokaa, Honomu, and Laupahoehoe, Hawaii, participating. The Territorial fair commissioners have arranged to send the winning team, together with a boy from the Garden Club at Kauai and five girls and boys from Maui, to the Territorial fair which is to be held at Honolulu from August 29 to September 4, 1927. These boys and girls will act as representatives of their respective clubs and enable the 4-H clubs of Oahu to participate in the interisland contests in canning, gardening, cooking, poultry and pig raising, and clothes making. The contests stimulate interest in club work throughout the islands and are of value in encouraging the successful contestants to strive for entry in the larger meets, including the regional and national 4-H club camps.



FIG. 5.—Thrifty Boys' Garden Club. Beet growers

#### CLUB RECREATIONAL ACTIVITIES

Lantern slides from the United States Department of Agriculture on culling hens for egg production, judging hogs, and home and school gardens were shown at the school fair at Hilo, to over 1,000 boys and girls on Maui, and to members of the agricultural clubs on Oahu. Boys of the 4-H clubs and members of the Thrifty Boys' Garden Club (fig. 5) with pennants, caps, and banners appropriate to the occasion, were well represented in the boys' day parade, which was held May 7, 1927. The wearing of caps and achievement pins has attracted considerable attention and as a result their awarding has been given a place in the school programs. Demonstrations on the proper methods of canning and soap making were combined with good social programs by several of the girls' clubs working conjointly.

Members of the boys' and girls' 4-H clubs in Hawaii have been invited to participate in the activities at the regional Camp Plummer, near Portland, Oreg., from October 29 to November 4, 1927; a section of the fair grounds has been allotted to livestock club members at the Territorial fair to be held at Honolulu from August 29 to

September 5, 1927; and members of the canning clubs have been invited to participate in the exhibits of two glass-jar companies on the mainland this fall. The Pollyanna Club of Honolulu was liberally rewarded by one of the companies for its exhibit at Chicago in December, 1926. (Fig. 6.) This is the first time that clubs so distantly situated have been encouraged to participate in contests on the



FIG. 6.—Pollyanna Club members

mainland. Another glass-jar company is offering cash prizes to the four most successful contestants of the canning club in Hawaii this year, and is paying for an exhibit of Hawaiian fruits, vegetables, and fish which is to be prepared by Maisie Leong, a fourth-year club member. Such recognition of the merits of the local club work is encouraging both to club leaders and club members.



